JWARS Space Strategic Partner (JSSPAR) Functionality Assessment

Space Representation in JWARS

Briefing to the Space Users Group

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13-14 December 2001

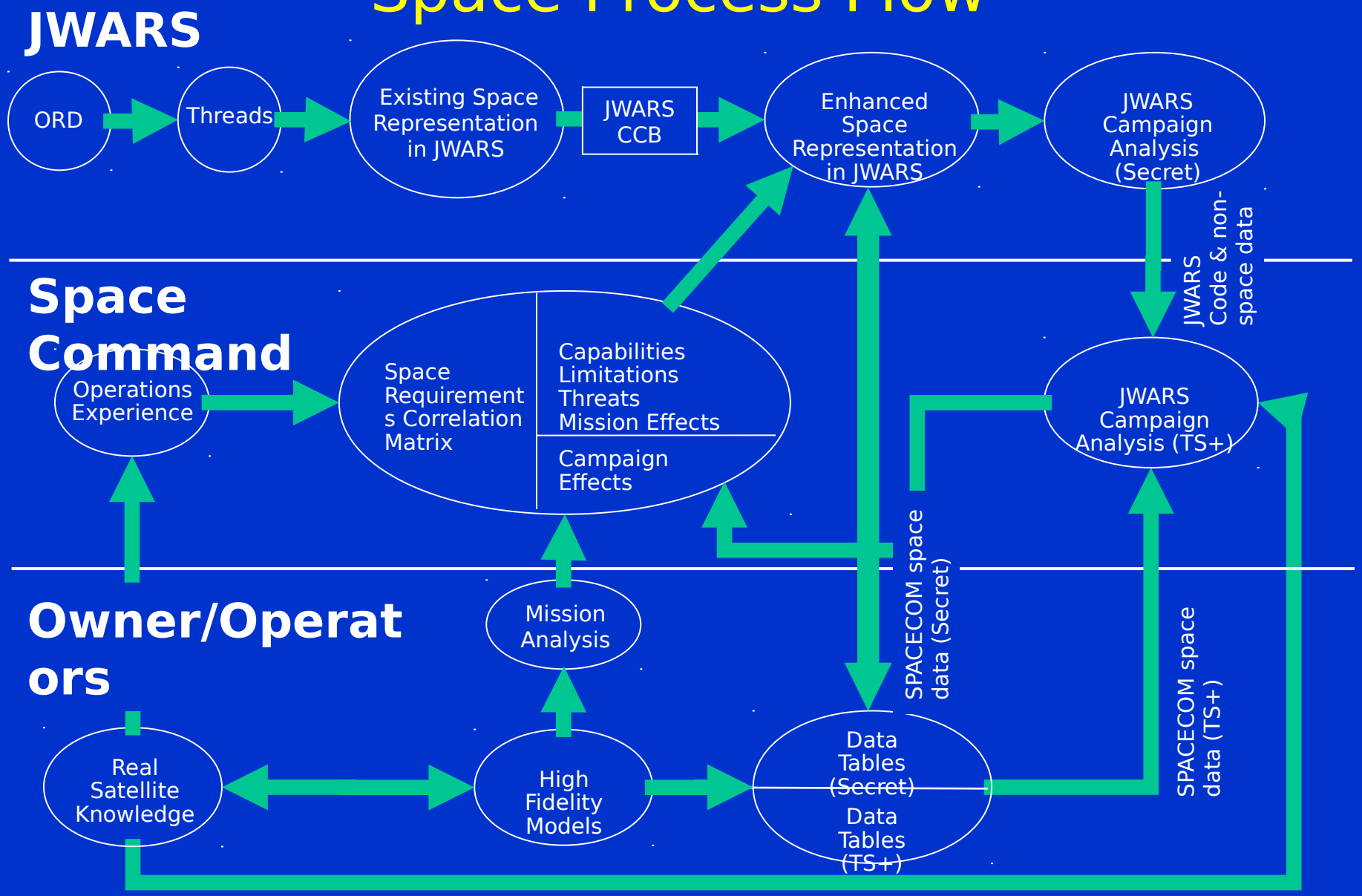
Agenda

- JSSPAR Tasks
- JWARS Overview
- Functionality Assessment Approach - Tasks 1 & 2
- Thread Analysis
- JWARS Thread Mapping to Space Mission Areas
- Space Requirements Correlation Matrix
- Space Mission Area Assessments
- Mission Area Rating
- JSSPAR Recommended Priorities
- Recommended Actions

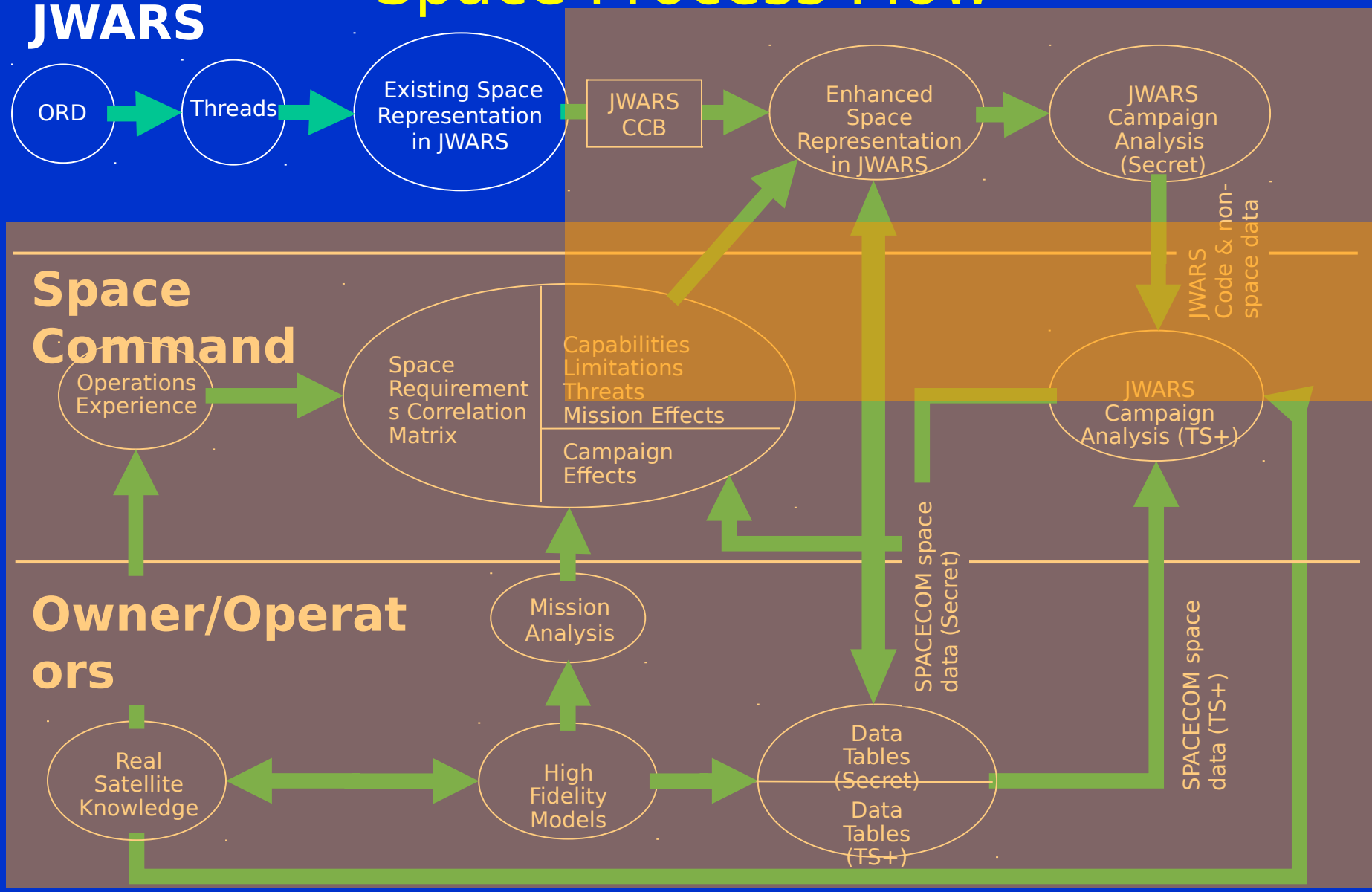
JSSPAR Tasks

- Task 1 - Assess current space functionality representation in JWARS
- Task 2 - Identify space functionality requirements using the USSPACECOM mission areas as a guide
- Task 3 - Prioritize requirements
- Task 4 - Mission space analysis work packages
- Task 5 - Joint functional description of the mission space
- Task 6 - JWARS object model
- Task 7 - Quantitative space effects of the warfighter repository
- Task 8 - Space representation in JWARS improvement plan
- Task 9 - Related activities (SPUG)

Space Process Flow



Space Process Flow



JWARS Overview

- JWARS Derives Requirements from its ORD
  - August 1998
- ORD defines three JWARS Releases
  - Release 1: Limited Initial Operational Capability- 1 May 2003
    - Ver 1.4 to be released May 2002
    - Ver 1.4 + Beta Testing = Ver 1.5
    - Ver 1.5 + Operational Testing = Ver 1.6 = LIOC
  - Release 2: Full Initial Operational Capability - Rel 1 + ~1 year
  - Release 3: Full Operational Capability - Rel 2 + ~1 year
- JWARS functionality is defined by Threads
  - Groupings of Measures of Performance of UJTL Tasks
  - Rel 1: 55 Threads, Rel 2: 72 Threads, Rel 3: 96 (TBD)
- ORD is light relative to Space Functionality Requirements

Functionality Assessment Approach Tasks 1 & 2

- Look at space functionality across JWARS, but evaluate each Thread independently
- Look at space functionality relative to the Space Mission Areas in Space Requirements Correlation Matrix
  - What space functionality is in Version 1.4?
  - What space functionality is planned for a later release?
  - What are the shortfalls?
  - What are the potential remedies?
- This is a space functionality assessment only - not an overall evaluation of JWARS functionality

Thread Number: 2.1.3, Prepare a Collection Plan

Intent
This thread develops the functionality to enable a command and control headquarters to determine which targets should be sensed, to sort the targets by their priority, and to determine which sensors/resources to employ to sense each target. The thread provides the functionality needed to permit a command and control headquarters to prepare an intelligence collection plan based upon its perception.

Task	MEA	J	Scale	MeasureDescription
OP 2.1.1	M6	1	Percent	Of PIRs covered by a Collection Plan.
OP 2.1.1	M7	1	Instances	Of PIRs identified after collection begins.
OP 2.1.3	M2	2	Percent	Of operations by enemy intelligence discovered in time to respond.
OP 2.1.3	M5	1	Percent	Of PIRs outstanding.
OP 2.1.4	M1	1	Hours	For joint force J-2 to receive report of organic collection assets from components (after arrival).
OP 2.2.1	M10	1	Instances	Of failure to respond to commander's requirements for reconnaissance or surveillance assets.
OP 2.2.1	M18	1	Percent	Of PIRs covered by more than one collection asset.
OP 2.2.1	M20	1	Percent	Of targets accurately identified.
OP 2.2.1	M21	1	Percent	Of targets accurately located.
OP 2.2.1	M29	1	Percent	Of commander's area that has reconnaissance and surveillance coverage.
OP 2.2.1	M6	1	Percent	Of collection requirements filled.
OP 2.2.2	M2	1	Hours	To provide theater of operations/JOA collected data to combatant command or national analysts.
OP 2.2.2	M3	2	Hours	To redirect surveillance or reconnaissance assets to meet new collection requirement.
OP 2.4.1.1	M5	1	Hours	To reassess new information on operational area.
OP 5.6.2	M1	1	Percent	Of C2W targets included in joint targeting plans.
OP 5.6.3	M1	1	Hours	After identifying new enemy C2 target, target attacked.
OP 5.6.3	M2	2	Hours	To change C2W plan upon receiving status updates.
ST 2.2.1	M24	1	Percent	Of reconnaissance and surveillance assets fully tasked.
ST 6.1.3	M3	2	Capability[Percent]	Of [requirements submitted to USSPACECOM, have] on-orbit assets available [for them.]

Current Space Functionality:

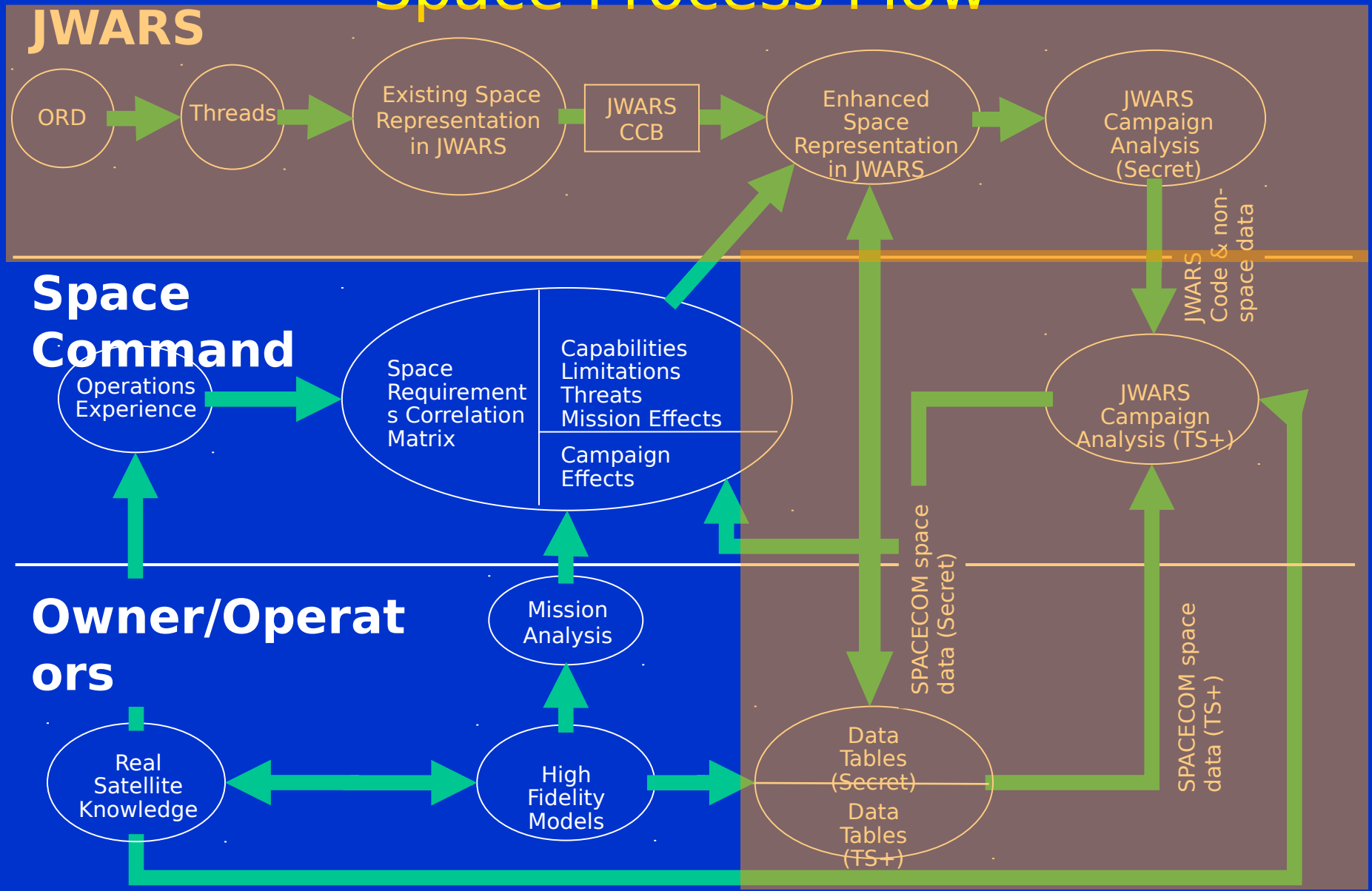
ISR: Space-based ISR sensors are user-selectable for any combination of platforms and sensor types. Coverage and availability represented as number of passes, on-station time per pass, and total area covered per pass - further limited by what area can be processed through PED. Sensors are specifically tasked in this thread, with characteristics as defined. Collect sensor data from all sources, discriminate BSEs by varying sensor resolutions.

Communications: Comm “providers” aggregated together, although potentially separable with supporting data. Real comm capabilities reflected in another thread.

Navigation: CEP not used in JWARS, so GPS effect on targeting not modeled. GPS not used for precision force movement. No GPS location accuracy modeled. ELINT finds cycling radars, but precision space-based geolocation accuracy data needed.

Operations: Satellites are specified in JWARS, and can be added or deleted

Space Process Flow



Threads Relate to Space Mission Areas

Thread	Thread Name	Space Mission Area	Applicable Space Systems / Mission Components								
			ISR	WARN	NAV	COMM	MET	Negate	Space Weapon	BFT	Launch/ Move
2.1.3	Prepare a Collection Plan	Warfighter Support Space System Operations	X		X	X					X
2.2.1A	Collect Information and Determine Enemy Courses of Action	Warfighter Support	X		X	X					
2.2.1B	Conduct Sensor Operations (Initial)	Warfighter Support	X		X		X				
2.2.1C	Conduct Sensor Operations (Additional)	Warfighter Support	X		X						
2.2.2A	Support Surveillance Requirements	Warfighter Support	X			X					
2.4.2.4	Provide Target Intelligence	Warfighter Support	X	X		X					
2.5.1	Produce and Provide Intelligence Products	Warfighter Support	X			X					
3.1.5A	Publish ATO (for Collection Operations)	Warfighter Support	X								
3.2.1B	Attack/Interdict Operational Targets (by Air) (Additional)	Warfighter Support Space Control Space System Operations Space Warfare	X	X		X		X	X		X
3.2.2	Counter-Space Operations	Warfighter Support Space Control Space System Operations	X	X	X	X	X	X			X
3.2.2.2	Electronic Attack	Warfighter Support				X					
3.2.6B	Provide Close Air Support	Space Warfare							X		
5.1.1	Communicate Information	Warfighter Support				X					
5.1.2A	Maintain and Enhance Communications	Warfighter Support	X			X					
5.1.2B	Reconstitute Destroyed Command and Control	Warfighter Support				X	X				
6.1.2	Provide Integrate Aerospace Defense	Warfighter Support Space Warfare	X	X		X			X		
6.1.5A	Conduct Maritime Theater Ballistic Missile Defense	Warfighter Support Space System Operations		X		X					X
6.1.5B	Conduct Integrated Joint Theater Ballistic Missile Defense	Warfighter Support Space Warfare		X		X			X		
6.2.5	Provide Positive Identification of Forces	Space Warfare								X	

- X indicates space functionality implied in UJTL tasks, aligned with applicable major space
- Highlighting indicates where explicit functionality is found in JWARS

Space Requirements Correlation Matrix - Inputs

Space Mission Area / Applicable Space Systems / Mission Components		Operational Thresholds	Operational Limitations	Threat to Space Mission Area	Mitigation of Threat	Impact of Inability to Perform Space Mission Area	Conventional Mission Area(s) Affected	Collateral Missions Affected
Warfighter Support (Formerly Force Enhancement)								
	ISR							
	DSP							
	GPS							
	SATCOM							
	Space Weather Environment							
	Space-Derived Weather							
Computer Network Operations								
	Computer Network Attack							
	Computer Network Defense							
Space Control								
	Protection							
	Prevention							
	Negation							
	Surveillance							
Space Systems Operations (Formerly Space Support)								
	Space Lift (Access to Space)							
	Satellite Operations (SATOPS)							
Space Warfare (Formerly Force Application)								
	Space-Based Radar (SBR)							
	Space-Based Blue Force Tracking (SB-BFT)							

Space Requirements Correlation Matrix - Expected Results from Campaign Analysis

Space Mission Area / Applicable Space Systems / Mission Components		Campaign-Level Area Affected	MOEs/MOPs
Warfighter Support (Formerly Force Enhancement)			
	ISR		
	DSP		
	GPS		
	SATCOM		
	Space Weather Environment		
	Space-Derived Weather		
Computer Network Operations			
	Computer Network Attack		
	Computer Network Defense		
Space Control			
	Protection		
	Prevention		
	Negation		
	Surveillance		
Space Systems Operations (Formerly Space Support)			
	Space Lift (Access to Space)		
	Satellite Operations (SATOPS)		
Space Warfare (Formerly Force Application)			
	Space-Based Radar (SBR)		
	Space-Based Blue Force Tracking (SB-BFT)		

Space Mission Area Assessment
Warfighter Support - ISR

- Current Functionality
  - Space-based ISR is aggregated into generic satellite platforms
    - Three platform types by function - EO/IR, Radar, SIGINT
    - Lumping can protect higher level classification
  - Orbits modeled as number passes per day and time per pass
  - Any sensor type can be put on any platform
  - Dynamic collection plan with user defined planning cycles reacts to changes and new facts from knowledge database
- Shortfalls
  - Collection planning based on targeting is lacking
    - BDA done in the course of collection by detecting change
  - SIGINT measures presence, type, volume of communication
    - No content or context modeled
  - No D&D modeled

Space Mission Area Assessment
Warfighter Support - ISR

- Remedy
  - Populate data tables
  - Continue to leverage work done to represent space-based ISR in JWARS with aggregated data at SECRET level and let space community substitute TS+ data for specific analysis
    - Briefed to SPUG in Feb 2000 by Mark Youngren, MITRE
    - Define pertinent performance factors for campaign level modeling
    - Continue dialog with NRO Analysis Center (NAC)
      - Now under Deputy Director for Systems Engineering
      - Col Kelley heads NAC
  - Model post-strike ISR collection - IMINT and SIGINT
  - Code ISR capabilities with performance-based parameters
    - USSPACECOM work with JWARS to replace generalized data tables with fast running algorithms whose inputs define general satellite performance over a wide range of environmental and operational conditions

Space Mission Area Assessment
Warfighter Support - DSP

- Current Functionality:
  - Independent satellite detection against single missile type
  - Pd based on available data
  - Cloud heights above launch site used vice LOS
    - Same weather present for all detectors regardless of location
  - DSP detection provides cue to TBMD forces for intercept
- Shortfalls:
  - Satellites are not modeled consistent with real-world use
  - Geometric constraints not sufficiently considered
  - Only primary DSP mission modeled in JWARS
    - Secondary and tertiary missions not employed

Space Mission Area Assessment
Warfighter Support - DSP (cont'd)

- Remedy:
  - Model DSP consistent with real-world operation
  - Consider utility of additional DSP capabilities in other JWARS IPTs

Space Mission Area Assessment
Warfighter Support - GPS

- Current Functionality:
  - GPS is not currently modeled in JWARS
    - Other available means of navigation diminish campaign effect
- Shortfalls:
  - Precision location determination or navigation data for weapons delivery and effect of loss not considered
    - Precision-guided munitions account for a significant percentage of weapons employed in the air war phase of current conflicts
    - Effect may include loss of aircraft carrying GPS-guided munitions that don't meet drop criteria and therefore don't deliver weapons
  - No consideration for contribution of precision timing signal used by communications equipment and effect of loss

Space Mission Area Assessment
Warfighter Support - GPS (cont'd)

- Remedy:
  - Model GPS based on USSPACECOM warfighter support data and run JWARS campaign analyses to determine effects
    - Careful attention to assumptions and inputs are critical
- Note:
  - AFSPACECOM/SWC did a GPS study with THUNDER
    - Showed GPS played no significant impact on outcome
  - Two subsequent studies have shown that GPS does have a campaign level effect

Space Mission Area Assessment
Warfighter Support - SATCOM

- Current Functionality
  - Communications BSEs are Providers, Subscribers, or both
    - Providers have network and message capability; Subscribers receive
  - Satellites contain single, many, or parts of networks
    - Networks can be divided into channels;
  - Comm functionality described in terms of message time delay
  - Comm types and delays based on DISA's NETWARS model
- Shortfalls
  - Capacities not separated into contributing components
    - No baseline systems; building satellite comm left to user
  - Message types and allocation across assets unknown
  - Effect of addition or deletion of particular satellite not separable
  - Conditional use of commercial capability not addressed
  - Rerouting of priority traffic from failed provider not modeled

Space Mission Area Assessment
Warfighter Support - SATCOM (cont'd)

- Remedy
  - Create satellite-based networks
  - Allocate message traffic realistically
    - Need data to know what information moves through which assets
  - Incorporate message prioritization scheme to ensure dissemination mirrors established priorities
  - Incorporate reroutes of all satellite data through backup providers to be defined by USSPACECOM
    - Could be other MILSATCOM or commercial
    - USSPACECOM needs to provide data
  - Add functionality to change message latency data when satellite communications assets are added or deleted
  - Coordinate with DISA as necessary for NETWARS impacts

Space Mission Area Assessment

Warfighter Support - Space Environment

- Current Functionality:
  - JWARS does not model effects of Space Environment on satellites and terrestrial systems
- Shortfalls:
  - Localized or systemic outages or performance degradation due to solar effects not considered
- Remedy:
  - Incorporate quantifiable Space Environment effects based on data to be provided by USSPACECOM
- Notes:
  - There are no data available that quantify the effects of space weather on satellites.
  - JHU/APL has been working this with USSPACECOM and JWARS

Space Mission Area Assessment

Warfighter Support - Weather Satellites

- Current Functionality
  - Weather truth data for the campaign are “known”
  - Two types of forecasting used
    - Perfect forecasting uses tomorrows truth as forecast
    - Persistence uses today’s weather as tomorrow’s forecast
- Shortfalls
  - Source of weather perception is not considered
  - Specific contributions by weather satellites not separable
- Remedy
  - Affect forecast for theater based on satellite presence or absence based on data from USSPACECOM, AFSPC, or NPOESS
- Note:
  - CACI is working with NRL on a forecasting model

Space Mission Area Assessment
Computer Network Operations

- Computer Network Attack
  - Current Functionality:
    - CNO is not modeled in JWARS
  - Shortfalls:
    - Effect of attack on enemy computer infrastructure not captured
  - Remedy:
    - Include in Electronic Attack thread
- Computer Network Defense
  - Current Functionality:
    - CNO is not modeled in JWARS
  - Shortfalls:
    - Effect of enemy attack on our computer infrastructure not captured
  - Remedy:
    - Include in Electronic Attack thread

Space Mission Area Assessment
Space Control - Protection

- Current Functionality:
  - Protection of space resources, including ground, space and launch segments and communications links, is not modeled in JWARS
  - Damage or destruction of ground assets is modeled, with associated MTTR
- Shortfall:
  - Damage or destruction of US space resources would adversely affect US capability
- Remedy:
  - Include in Counter Space Operations thread

Space Mission Area Assessment
Space Control - Prevention

- Current Functionality:
  - Prevention of enemy use of US space assets is not modeled in JWARS
- Shortfalls:
  - Susceptibility to enemy use of US space systems could bolster their capability and lessen availability for US use
    - GPS selective availability was a good example of this
- Remedy
  - Include in Counter Space Operations thread

Space Mission Area Assessment
Space Control - Negation

- Current Functionality:
  - No current functionality
  - Destruction of enemy space capability addressed in future threads
    - includes attacks on the ground, launch, link and/or space segments of the target system
- Shortfalls:
  - Unchallenged enemy space capability remains a threat
- Remedy:
  - Include in Counter Space Operations thread

Space Mission Area Assessment
Space Control - Surveillance

- Current Functionality:
  - Surveillance of space systems is not modeled in JWARS
- Shortfalls:
  - Presence or absence of enemy space systems will not be known or updated through the campaign
    - Enemy satellite assets provide capability and are potential targets
    - Our reaction to adversary ISR satellite capability, offensive or defensive, not modeled
- Remedy:
  - Include space surveillance functionality in Counter Space Operations thread

Space Mission Area Assessment
Space Operations - Space Lift

- Current Functionality:
  - Satellite launch is not modeled in JWARS, but assets can be added in a time-phased manner to represent launch or maneuver
  - Sufficient functionality exists without modeling launch and orbit insertion processes
- Shortfalls:
  - None
- Remedy:
  - None required
- Note:
  - Data to support satellite launch and move decisions lacking

Space Mission Area Assessment

Space Operations - Satellite Operations

- Current Functionality:
  - Loss of satellite modeled as an availability for a particular “detection” or as complete loss for remainder of campaign
  - Satellite orbital maneuvering is not modeled in JWARS, but simulated through phasing resources in or out
- Shortfalls:
  - Platform loss, through destruction or “natural causes” is not considered
  - Causal relationship of satellite outages not modeled
    - Nature of outage drives corrective action - reprogram or replace
- Remedy:
  - Tie satellite operations functionality to negation aspect of Counter Space Operations, protection and denial aspects of Electronic Attack, and satellite effects aspect of Space Weather

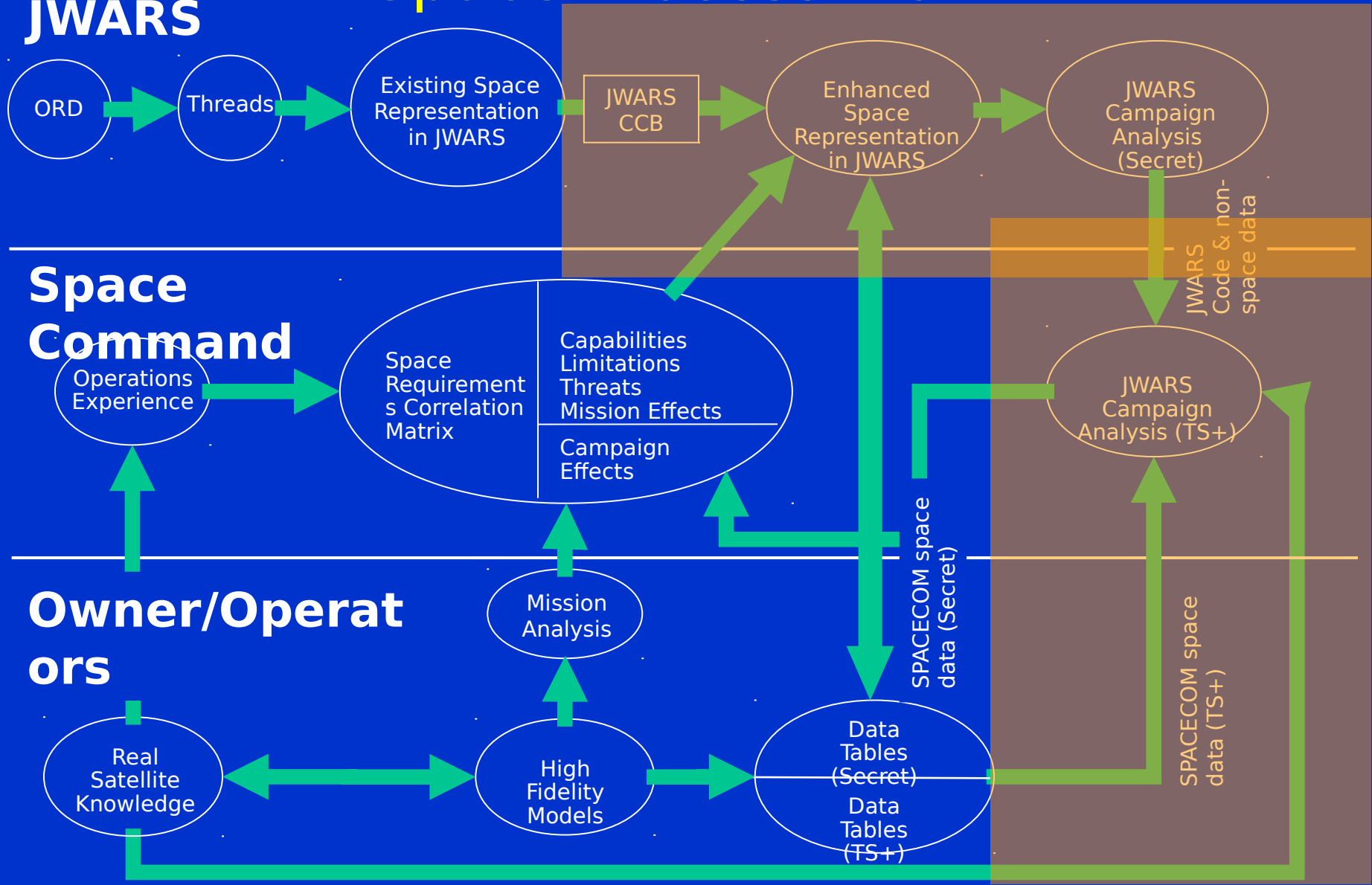
Space Mission Area Assessment
Space Warfare - Space-Based Radar

- Current Functionality:
  - MTI/SAR sensor can be attached to a satellite platform in JWARS at scenario setup, but SBR as a specific system isn’t modeled
  - User can represent a satellite constellation by summing coverage opportunities for individual satellites or providing system coverage statistics
  - Capabilities are data-driven
- Shortfalls:
  - None
- Remedy:
  - None required

Space Mission Area Assessment
Space Warfare - Blue Force Tracking

- Current Functionality:
  - No current JWARS functionality for space-based BFT
- Shortfalls:
  - Unable to distinguish “us” from “them” in some cases
- Remedy:
  - Include in future thread that addresses positive identification of forces

Space Process Flow



Mission Area Rating

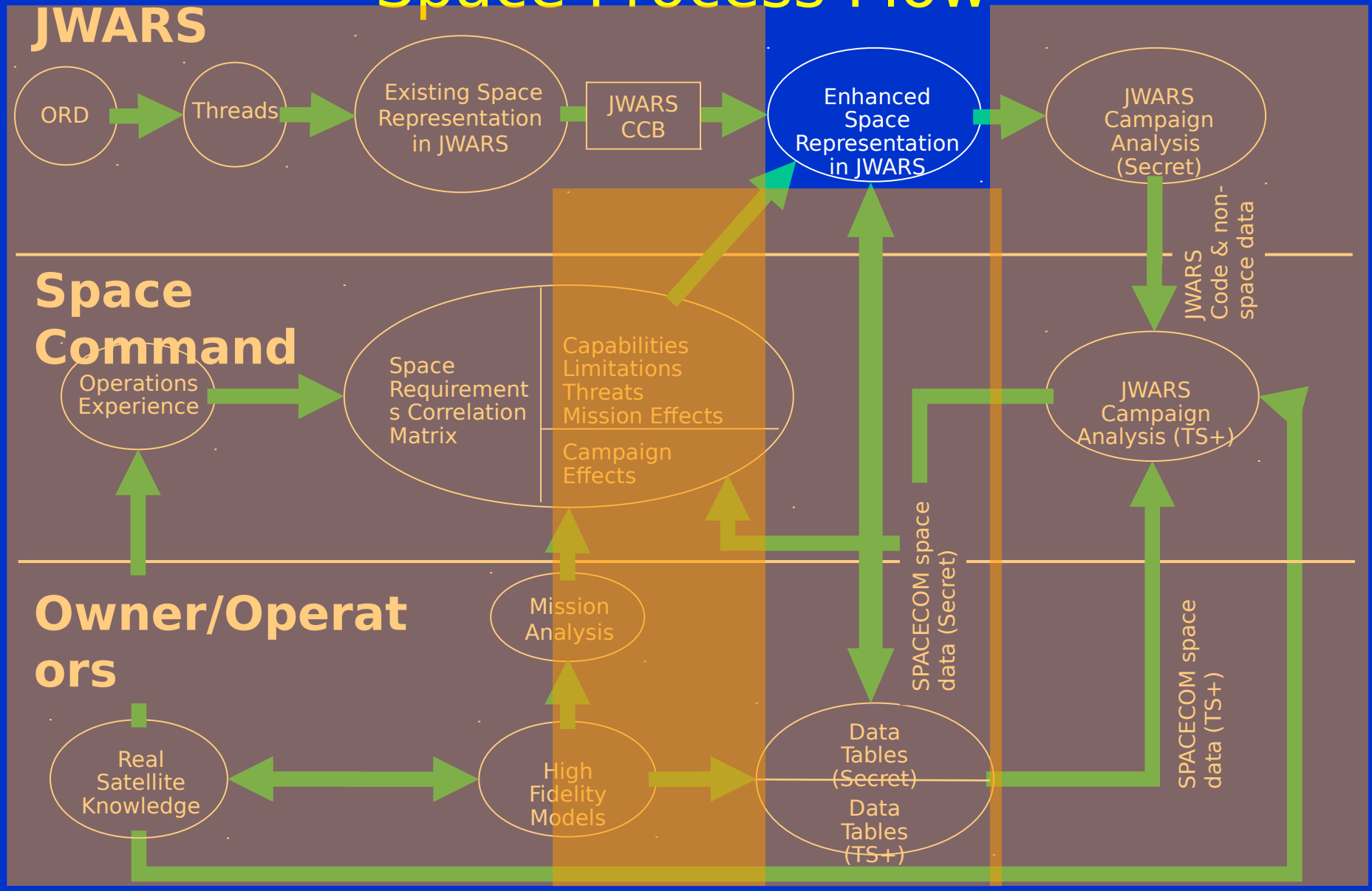
- Mission area rating assesses Version 1.4 functionality
  - Future functionality not present but planned for future versions assessed the same as unplanned functionality
- Keys:
  - Functionality:
    - Green: Satisfactory space functionality in this area with potential for minor improvements
    - Yellow: Evidence of preliminary functionality with need for significant improvement or modification
    - Red: No apparent functionality
  - Data:
    - Green: Data sufficient for campaign analysis
    - Yellow: Some good data exist, but more are needed
    - Red: Good data are essentially lacking

Mission Area Rating

Space Mission Area Applicable Space Systems / Mission Components	Functionality Assessment	Data Sufficiency Assessment	Area Addressed in J WARS ORD
Warfighter Support (Formerly Force Enhancement)	**Yellow**	**Red**	
ISR	**Green**	**Red**	Plan/Collect ISR
DSP	**Yellow**	**Yellow**	TBMD
GPS	**Red**	**Red**	
SATCOM	**Yellow**	**Yellow**	Communication
Space Weather Environment	**Red**	**Red**	
Space-Derived Weather	**Red**	**Red**	
Computer Network Operations	**Red**	**Red**	
Computer Network Attack	**Red**	**Red**	Electronic Attack
Computer Network Defense	**Red**	**Red**	Electronic Attack
Space Control	**Red**	**Red**	
Protection	**Red**	**Red**	Counter Space Ops
Prevention	**Red**	**Red**	Counter Space Ops
Negation	**Red**	**Red**	Counter Space Ops
Surveillance	**Red**	**Red**	Counter Space Ops
Space Systems Operations (Formerly Space Support)	**Yellow**	**Red**	
Space Lift (Access to Space)	**Green**	**Red**	
Satellite Operations (SATOPS)	**Yellow**	**Red**	
Space Warfare (Formerly Force Application)	**Yellow**	**Red**	
Space-Based Radar (SBR)	**Green**	**Red**	Plan/Collect ISR
Space-Based Blue Force Tracking (SB-BFT)	**Red**	**Red**	Positive Force ID

Component area assessments are rolled up into overall Space Mission Area assessments

Space Process Flow



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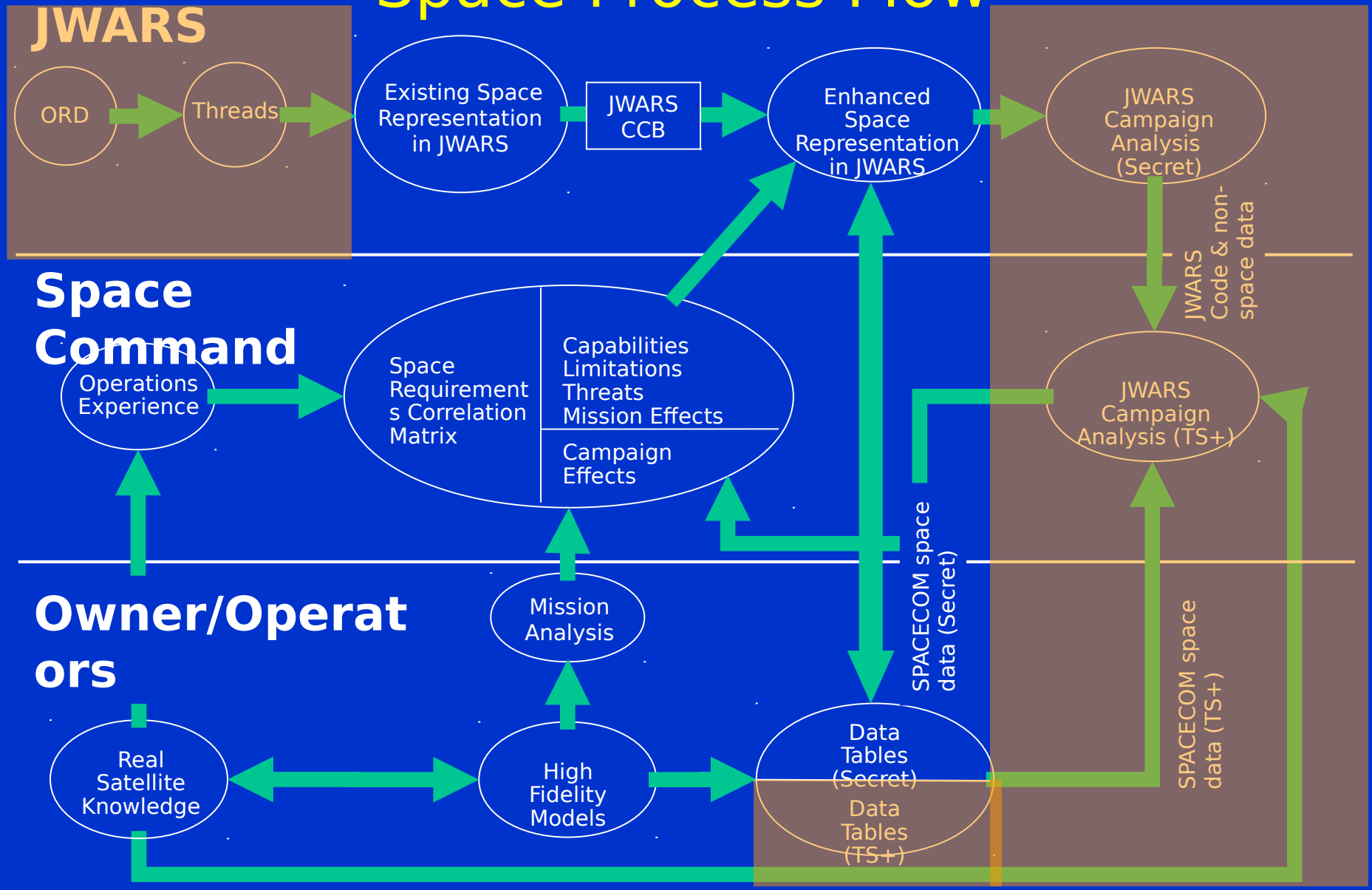


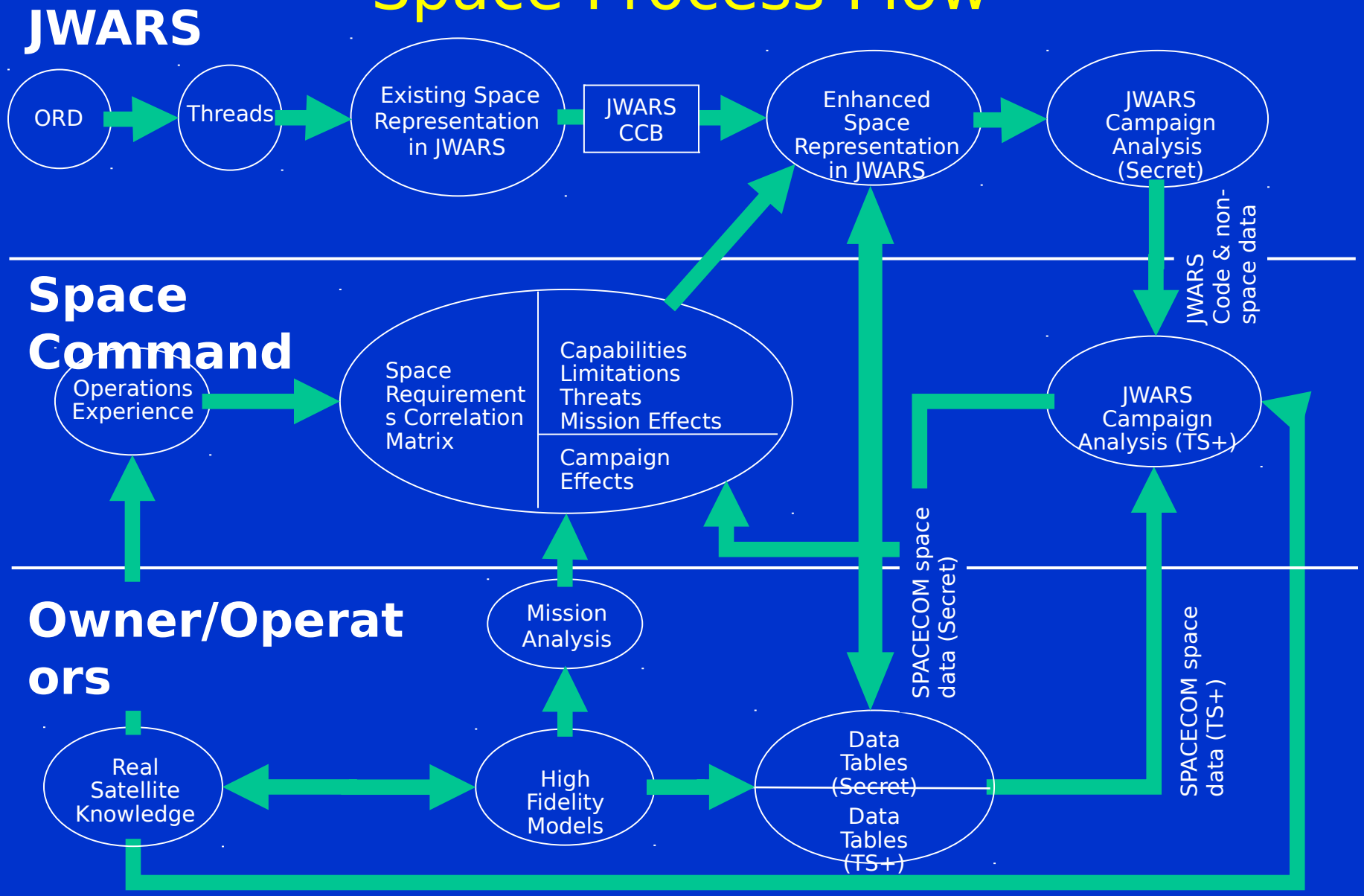
JSSPAR Recommended Priorities

- ISR and DSP should be first priorities for enhancement
  - Provide greatest potential for increased space functionality
  - Improvement of DSP representation
    - Ready DSP for transition to SBIRS High as data available
    - Add functionality to mirror real-world CONOPS
    - Review recommendations from Clyde Smithson's earlier work
  - Improvement of ISR representation
    - ISR improvement is mostly a data issue
    - Continue to seek aggregated performance data
    - Add functionality to support "dynamic retasking" of ISR sensors
- Define data tables with probability look-ups
  - Structure of ISR/SBR is sufficient, but need data
  - Other areas need key parameters ID'd to better define tables
  - USSPACECOM take lead on population of space data tables

Recommended Actions

1. US Space Command
   - Provide access to SMEs to facilitate design of tables that capture sufficient satellite operational parameters for campaign analysis
2. JSSPAR
   - Work with JWARS and USSPACECOM to define data tables needed for accurate space representation
3. JWARS
   - Code JWARS to read from tables in advance of actual data
4. US Space Command
   - Populate data tables with probabilities
     - Detection capabilities, capacities and availability of space systems
     - Vulnerabilities, susceptibilities, and limitations
       - Weather, jamming, space environment, ...

Space Process Flow



Backup Charts